Long-term on-chip storage and release of liquid reagents for diagnostic lab-on-a-chip applications

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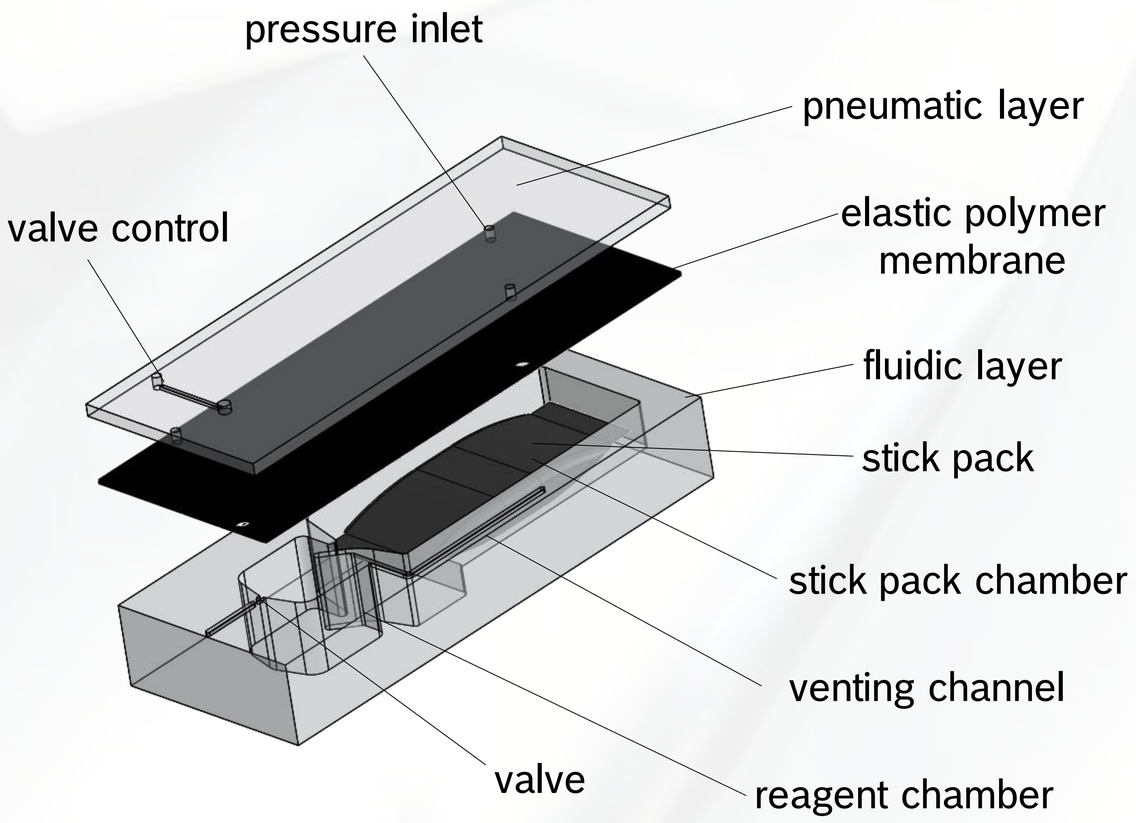
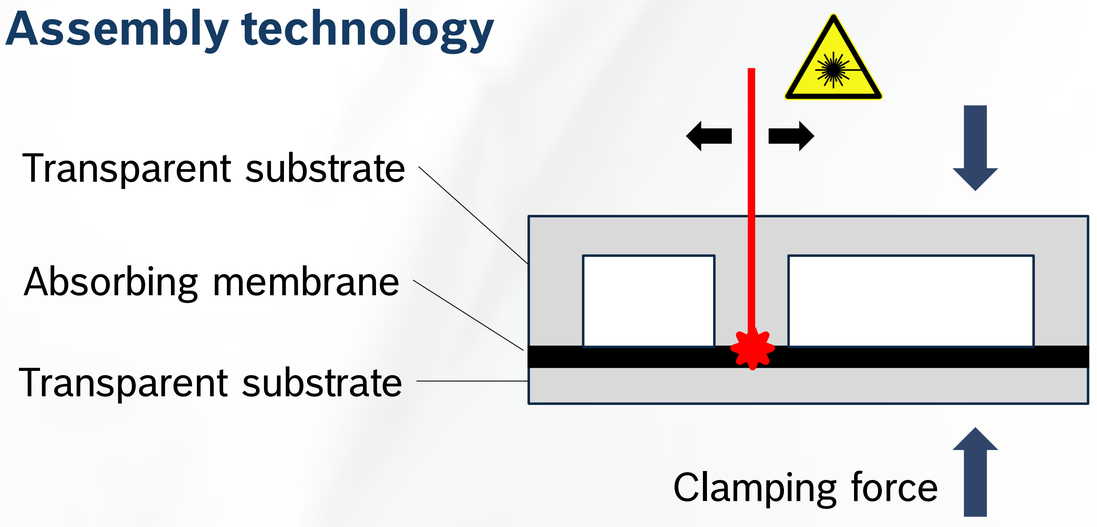
Introduction

- On-chip reagent storage enables massive advantages for diagnostic lab-on-a-chip (LoC) applications.
- Here, we present a low-cost, polymer multilayer stack with integrated stickpacks for long-term storage of liquid reagents at room temperature. Reagent release is realized by pushing an elastomer membrane against the stick pack through pneumatic pressure.
- Compared to existing solutions [1-2] this storage concept can be implemented into pressure-driven LoC-devices [3].

Stick pack integration in polymer multilayer stack



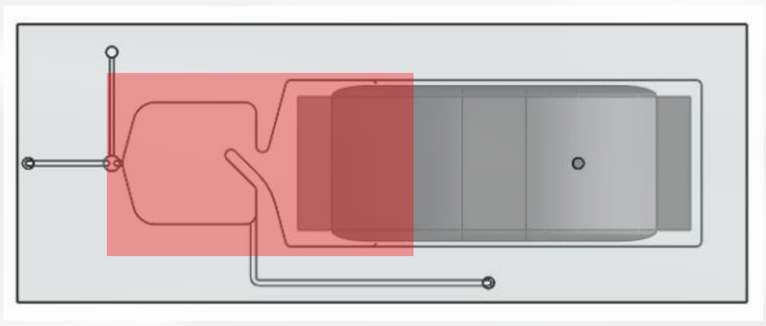
Assembly technology



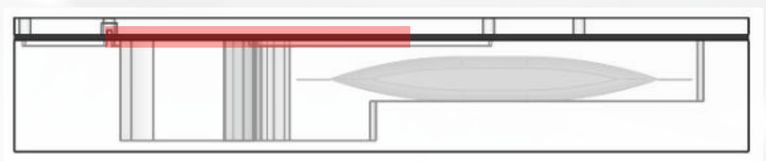
- Laser radiation welding from both sides (cw@1064nm) is used for joining polymer multilayer stack.

Operation mode of reagent release

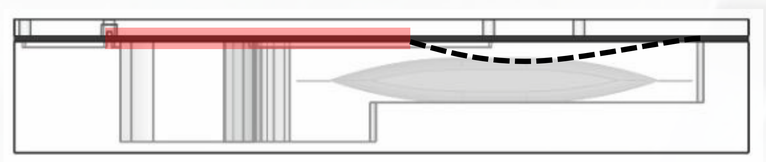
- **Initial state (top view)**



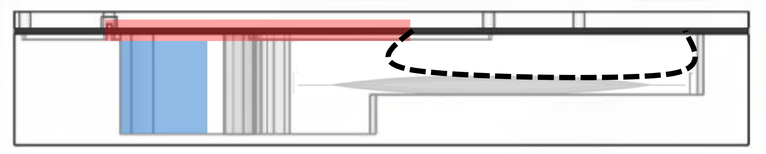
- **Initial state (side view)**



- **Pneumatic actuation of membrane**



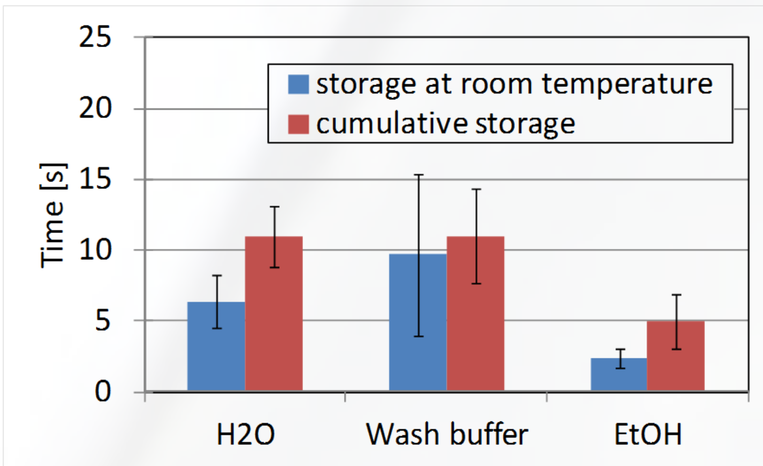
- **Delamination of peel seam and reagent release**

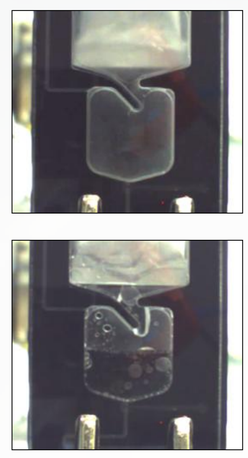


Membrane fixed to pneumatic layer

Results

- Cumulative storage of stick packs including cycles of high thermal stress generates reagent losses below 0,1%.
- A repeatable pressure-driven opening of stick packs could be demonstrated.
- Stick packs filled with H_2O, wash buffer and EtOH show opening delays below 30s for RT and cumulative storage.





Opening delay of stick packs and releasing process

Conclusions

This concept enables long-term on-chip storage of liquid reagents at room temperature and reagent release on demand.

- **Long-term storage:** Minimal reagent loss for highly volatile reagents containing EtOH
- **Repeatable release:** Pressure-driven opening of stick packs even after accelerated aging is statistically proven
- **Easy implementation:** Transferable into pressure-driven LoC platforms with great freedom of placement

[1] T. van Oordt et al., Lab Chip 15 (2013) 2851-3138
[2] J. Hoffmann et al., Lab Chip 10 (2010) 1480-1484
[3] J. Rupp et al., Journal Micro. and Elect. Pack. 4 (2009) 1551-4897

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